__Claims__

No amendments are made with this response. Following is a listing of the pending claims.

1. (Previously presented) A method of injecting a liquid sample into an electrolyte channel in a microfluidics device having a channel network that includes an electrolyte channel having upstream and downstream channel portions and first, second, and third side channels that intersect the electrolyte channel between the two channel portions at first, second, and third ports, respectively, where at least one of the ports is axially spaced along the electrolyte channel from the other two ports, said method comprising

(a) supplying a sample to the first side channel,

(b) applying across the first side channel and at least one of the other two side channels, a voltage potential effective to move sample in the first channel into a volume element of the electrolyte channel extending between the first port and at least one other port which is axially offset from the first port,

(c) simultaneously controlling the voltage applied to the three side channels, and optionally, at least one of said upstream and downstream channel end portions, to create a sample volume element in the electrolyte channel that has a desired leading- and trailing-edge shape and/or distribution of sample components within the volume element, and

(d) simultaneously controlling the voltage applied to the upstream and downstream channel portion, and to at least two of the side channels, to advance the sample element having a desired leading- and trailing-edge shape and/or distribution of sample components in a downstream direction within the electrolyte channel.

2. (Original) The method of claim 1, for use in injecting a sample containing a plurality of sample components in a volume element of the sample components, wherein:

the first port is axially disposed between the second and third ports,

applying step (b) is effective to move sample in the first channel into a volume element of the electrolyte chamber extending between the second and third ports, and

controlling step (c) is effective to move an electrolyte solution from the upstream channel portion through the second port and an electrolyte solution from the downstream portion through the third port, thus to sharpen the upstream and downstream boundaries of the sample volume.

3. (Previously presented) The method of claim 1, wherein the first port is axially aligned with the second port.

4. (Original) The method of claim 2, wherein the first port is axially spaced from the second and third ports.

5. (Original) The method of claim 2, wherein controlling step (d) is effective to move an electrolyte solution in the upstream channel portion successively through the second, first and third ports, to move sample contained in the three side channels away from the electrolyte channel.

6. (Original) The method of claim 1, for use in injecting a sample containing a plurality of sample components in a volume element, and prestacking the sample components within the volume element according to their electrophoretic mobilities, wherein:

the sample contains a plurality of components with different electrophoretic mobilities and one of a leading-edge ion having an electrophoretic mobility greater than that of said sample components or a trailing-edge ion having an electrophoretic mobility less than that of said sample components,

the first port is axially disposed between the second and third ports,

applying step (b) is effective to move sample in the first channel into a volume element of the electrolyte chamber extending between the second and third ports,

controlling step (c) is effective to move an electrolyte solution from the upstream channel portion through the second port and an electrolyte solution from the downstream portion through the third port, thus to sharpen the upstream and downstream boundaries of

the sample volume, where the electrolyte solution in both the upstream and downstream portions includes the other of the leading-edge or trailing-edge ion, and

controlling step (d) is initially effective in stacking the sample components in the sample volume in accordance with their electrophoretic mobilities, by isotachophoretic separation.

7. (Original) The method of claim 6, wherein controlling step (d) is effective to move an electrolyte solution in the upstream channel portion successively through the second, first and third ports, to move sample contained in the three side channels away from the electrolyte channel.

8. (Original) The method of claim 1, for use in injecting a sample containing a plurality of sample components in a volume element, and prestacking the sample components within the volume element according to their electrophoretic mobilities, wherein:

the sample contains a plurality of components with different electrophoretic mobilities,

the second port is axially disposed between the first and third ports,

applying step (b) is effective to move sample in the first channel into a volume element of the electrolyte chamber extending between the first and second ports,

controlling step (c) is effective to move a solution containing one of a leading-edge ion having an electrophoretic mobility greater than that of said sample components or a trailing-edge ion having an electrophoretic mobility less than that of said sample components from the third channel into the second channel, and

controlling step (d) is initially effective in stacking the sample components in the sample volume in accordance with their electrophoretic mobilities, by isotachophoretic separation.

9. (Original) The method of claim 8, wherein controlling step (d) is effective to move an electrolyte solution in the upstream channel portion successively through the second, first and third ports, to move sample contained in the side channels away from the electrolyte channel.

10. (Original) The method of claim 1, for use in injecting a sample containing one or more sample components, and concentrating the component(s) at the upstream or downstream side of the sample volume, wherein:

the first, second, and third ports are axially spaced from one another, and the second port is disposed between the first and third ports,

applying step (b) includes applying a DC voltage potential across the first and second side channels, to move sample in the first channel into a volume element of the electrolyte chamber extending between the first and second ports, and

controlling step (c) includes applying an AC voltage between the third side channel and an upstream or downstream channel portion, to form a dielectric focusing field adjacent the upstream or downstream end of the sample plug effective to concentrate sample components in the sample volume at an end of the sample volume adjacent the channel portion to which the AC voltage is applied.

11. (Original) The method of claim 10, wherein

the first, second, and third ports are positioned along the electrolyte channel in an upstream-to-downstream direction, and

controlling step (c) includes applying an AC voltage between the upstream channel portion and the third side channel.

12. (Original) The method of claim 10, wherein the first and third channels are axially aligned or nearly so on opposite sides of the electrolyte channel, the second channel is axially spaced from the first and third channels, and

controlling step (c) includes applying an AC voltage between the third channel and the adjacent upstream or downstream channel end portion.

13. (Previously presented) A microfluidic system designed for use in injecting a defined-volume liquid sample into an electrolyte channel, for transport through the channel, comprising

a microfluidic device having a channel network that includes such an electrolyte channel having upstream and downstream channel portions and first, second, and third side channels that intersect the electrolyte channel between the two channel portions at first, second, and third ports, respectively, where at least one of the ports is axially spaced along the electrolyte channel from the other two ports,

ports for supplying liquid medium to the electrolyte channel and the side channels,

upstream and downstream electrodes, and first, second, and third electrodes adapted to communicate with liquid medium contained in upstream and downstream portions of the electrolyte channel, and the first, second, and third side channels, respectively, and

a voltage controller operatively connected to the upstream downstream, and first, second, and third electrodes, which operates to

(a) apply across the first side channel and at least one of the other two side channels, a voltage potential effective to move a liquid sample contained in the first channel into a volume element of the electrolyte chamber extending between the first and at least one other port which is axially offset from the first port,

(b) simultaneously control the voltage applied to the three side channels, and at least one of said upstream and downstream channel end portions, to create a sample volume element in the electrolyte channel that has a desired leading- and trailing-edge shape and/or distribution of sample components within the volume elements, and

(c) simultaneously control the voltage applied to the upstream and downstream channel portion, and to at least two of the side channels, to advance the sample element having a desired leading- and trailing-edge shape and/or distribution of sample components in a downstream direction within the electrolyte channel.

14. (Original) The system of claim 13, for use in injecting a sample containing a plurality of sample components in a volume element of sample components, wherein:

the first port is axially disposed between the second and third ports,

applying step (b) is effective to move sample in the first channel into a volume element of the electrolyte chamber extending between the second and third ports, and

controlling step (c) is effective to move an electrolyte solution from the upstream channel portion through the second port and an electrolyte solution from the downstream portion through the third port, thus to sharpen the upstream and downstream boundaries of the sample volume.

15. (Original) The system of 14, wherein controlling step (d) is effective to move an electrolyte solution in the upstream channel portion successively through the second, first and third ports, to move sample contained in the three side channels away from the electrolyte channel.

16. (Original) The system of claim 13, for use in injecting a sample containing a plurality of sample components in a volume element, and prestacking the sample components within the volume element according to their electrophoretic mobilities, where the sample contains a plurality of components with different electrophoretic mobilities and a leading-edge ion having an electrophoretic mobility greater than that of said sample components, wherein

the first port is axially disposed between the second and third ports,

applying step (b) is effective to move sample in the first channel into a volume element of the electrolyte chamber extending between the second and third ports,

controlling step (c) is effective to move an electrolyte solution from the upstream channel portion through the second port and an electrolyte solution from the downstream portion through the third port, thus to sharpen the upstream and downstream boundaries of the sample volume, where the electrolyte solution in both the upstream and downstream portions includes a trailing-edge ion having an electrophoretic mobility less than that of said sample components, and

controlling step (d) is initially effective in stacking the sample components in the sample volume in accordance with their electrophoretic mobilities, by isotachophoretic separation.

17. (Original) The system of claim 13, for use in injecting a sample containing a plurality of sample components in a volume element, and prestacking the sample

components within the volume element according to their electrophoretic mobilities, where the sample contains a plurality of components with different electrophoretic mobilities and a leading-edge ion having an electrophoretic mobility greater than that of said sample components, wherein:

the second port is axially disposed between the first and third ports,

applying step (b) is effective to move sample in the first channel into a volume element of the electrolyte chamber extending between the first and second ports,

controlling step (c) is effective to move a solution containing one of a leading-edge ion having an electrophoretic mobility greater than that of said sample components or a trailing-edge ion having an electrophoretic mobility less than that of said sample components from the third channel into the second channel, and

controlling step (d) is initially effective in stacking the sample components in the sample volume in accordance with their electrophoretic mobilities, by isotachophoretic separation.

18. (Original) The system of claim 13, for use in injecting a sample containing one or more sample components, and concentrating the component(s) at the upstream or downstream side of the sample volume, wherein:

the first, second, and third ports are axially spaced from one another, and the second port is disposed between the first and third ports,

applying step (b) includes applying a DC voltage potential across the first and second side channels, to move sample in the first channel into a volume element of the electrolyte chamber extending between the first and second ports, and

controlling step (c) includes applying an AC voltage between the third side channel and an upstream or downstream channel portion, where the first and second ports are disposed between and spaced from the third side channel and channel portion to which the AC voltage is applied, thereby to concentrate sample components in the sample volume at an end of the sample volume adjacent the channel portion to which the AC voltage is applied.

19. (Original) The system of claim 13, for use in injecting a sample containing one or more sample components, and concentrating the component(s) at the upstream or downstream side of the sample volume, wherein:

the first and third channels are axially aligned or nearly so on opposite sides of the electrolyte channel, the second channel is axially spaced from the first and third channels

applying step (b) includes applying a DC voltage potential across the first and second side channels, to move sample in the first channel into a volume element of the electrolyte chamber extending between the first and second ports, and

controlling step (c) includes applying an AC voltage between the third channel and the adjacent upstream or downstream channel end portion between the third side channel and an upstream or downstream channel portion, thereby to concentrate sample components in the sample volume at an end of the sample volume adjacent the channel portion to which the AC voltage is applied.